

Biodiversity and Ecosystems

Oceans and Coasts

Key Findings

- Oceans and coastal regions are critical to the social and economic well-being of North America. The continent's coastal and offshore marine ecosystems are home to a remarkable diversity of species, including marine mammals, fish, invertebrates and plants. Coastal regions also lay claim to some of the continent's highest population densities and rates of population growth.
- North America's oceans and coastal regions provide a wide range of goods and services, such as fisheries, trade routes, recreation and tourism, and oil and gas production. Direct human uses, coupled with the impacts of climate change, affect the condition of these ecosystems and their biodiversity.
- The diversity of coastal ecosystems and the variability of human activity affecting them complicate efforts to summarize overall conditions. In general, coastal ecosystems are subject to substantial cumulative impacts from human activities, particularly from development and land use change. Offshore, the productivity of certain fisheries has been greatly reduced by harvesting pressures.
- Despite progress using ecosystem approaches to management and the precautionary approach, trends in North America show continuing overfishing in some areas and ongoing challenges related to land use change, habitat damage and bycatch. Climate change is expected to impose additional stress on marine and coastal ecosystems, with particularly profound effects in the Arctic Ocean from both environmental changes (such as a shrinking sea ice cover) and the associated increase in economic activity.

Oceans—the continuous saltwater bodies that cover more than 70 percent of the earth's surface—shape its climate, provide a means of transport and are home to an important part of the planet's biodiversity. **Oceans and coasts**—where land meets the sea—provide a wide range of valued goods and services, including fisheries, trade routes, recreation and tourism, oil and gas production and ecological diversity.

What Is the Environmental Issue?

Coastal and marine ecosystems support some of the most productive and valuable habitats in the world, including estuaries, coastal wetlands, beaches, mangrove forests, seagrass meadows, coral reefs, sea mounts and upwelling areas. In the three North American countries, these ecosystems extend up to 100 kilometers inland and fully across their marine jurisdictions. The health of these habitats depends on the quality of the ecosystems' physical and chemical processes and associated biological communities. Their degradation and loss affect the viability and productivity of invaluable natural resources.

Globally, coastal areas produce disproportionately more ecosystem services than

most other geographic areas, even those with a larger total geographic extent. At the same time, these ecosystems are experiencing the most rapid environmental change. During the last few decades over a third of mangroves have been lost or converted in countries that monitor these areas. Similarly, approximately 20 percent of coral reefs have been destroyed and an additional 20 percent or more degraded globally. In some countries, the decline of coastal wetlands is reaching 20 percent a year. In the Arctic Ocean, the effects of climate change on marine and coastal areas are already evident or are expected. These effects include loss of sea ice cover, shoreline erosion, flooding caused by rising sea levels and melting permafrost.



Miami, Florida, USA.



Atlantic salmon smolts. Photo: US Fish and Wildlife Service.

A recent global analysis of the cumulative effects of human activities on the oceans found that ecosystems with the highest predicted cumulative impact scores are the hard and soft continental shelves and rocky reefs. Almost half of all coral reefs were categorized as experiencing medium-high to very high impacts. Shallow soft-bottom and pelagic deepwater ecosystems experienced the lowest impact because of the lower vulnerability of these ecosystems to most anthropogenic drivers. Overall, the results highlight the greater cumulative impact of human activities on coastal ecosystems (see map). This analysis does not, however, fully account for the emerging pressures in Arctic coastal ecosystems from the effects of climate change.

Why Is This Issue Important to North America?

Marine resources and coastal areas are important contributors to North America's social and economic well-being. Indeed, the continent's coastal areas are characterized by some of its highest population densities and rates of population growth. As of 2000, 36 percent of the total North American population lived within 100 kilometers of the coast.

Fisheries

Fisheries play a critical role in North America's coastal economies, but ongoing improvements are needed in the management of these resources to ensure their long-term sustainability.

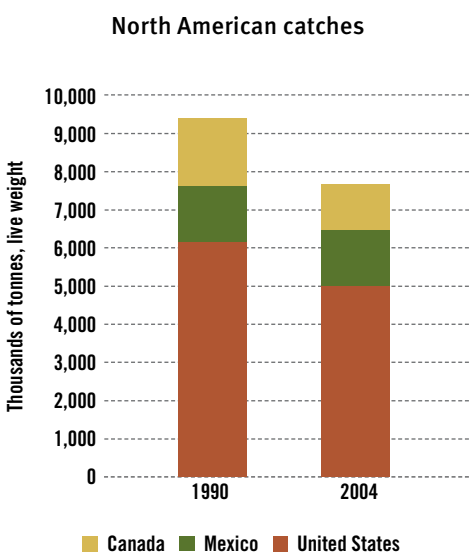
Canada harvests more than 100 commercially valuable species of fish. In 2004 it ranked as the sixth-largest exporter of fish and fishery products in the world, generating revenues of over C\$2 billion. The major marine finfish species in Canada are hake, redfish, cod, herring, salmon and capelin; shellfish products include shrimp, scallop, lobster and snow crab. However, fisheries in Canada are not without problems. Many of the groundfish fisheries off the Atlantic coast and Pacific salmon stocks have declined precipitously. To ensure sustainability and manage the impacts of fishing on sensitive areas, Canada is adopting a precautionary and ecosystem-based management approach to fisheries. In 2004 Canada announced a vision for a renewed fishery sector that aims to improve the economic and biological performance of Canadian fisheries based on these principles.

Mexico is one of the top 20 seafood producers in the world, contributing 1.5 percent of total world fisheries production by weight. Mexico's marine ecosystems also offer other economic benefits that are even more valuable—the coral reefs, clear tropical waters and white sand beaches that serve as a draw for Mexico's lucrative tourism industry. And yet industrial and coastal development, agriculture and tourism have all strained Mexico's ecosystems, and it has not been able to maintain the nearly exponential growth in fisheries that occurred in the final decades of the last century, in part because of the collapse of the anchovy fishery. Stagnant or declining catches, overexploitation of socially important species for artisanal fisheries, and a scarcity of rural development alternatives have created challenges, especially in places where fisheries have great local importance such as Sinaloa and Sonora.

The United States is the third-largest seafood producer country in world behind China and Peru, based on the value of marine and inland capture fisheries. As of 2004, the United States was the fourth-largest exporter and second-largest importer of fish and fishery products by value. Overall, the status of some US fishery stocks have improved, and others have declined. The number of stocks considered "overfished" increased from 43 in 2005 to 47 in 2006. Stocks that are overfished have biomass levels below biological thresholds specified in their fishery management plans. The number of stocks "subject to overfishing" increased from 45 to 48. A stock that is subject to overfishing has a fishing harvest rate above the level that provides for the maximum sustainable yield. The majority of the 530 assessed stocks in the United States are either not overfished (75 percent) or subject to overfishing (80 percent). In the United States, legislation signed in 2007 contains significant new provisions to end overfishing, promote market-based approaches to fisheries management, improve fisheries science, enhance international cooperation and address illegal, unreported and unregulated fishing, as well as bycatch of protected species.

Over time, the significant fishing industries in all three North American countries have experienced declining production. In 2004 North American commercial landings were over 7.6 million tonnes, a reduction of almost 20 percent since 1990 (see graph).

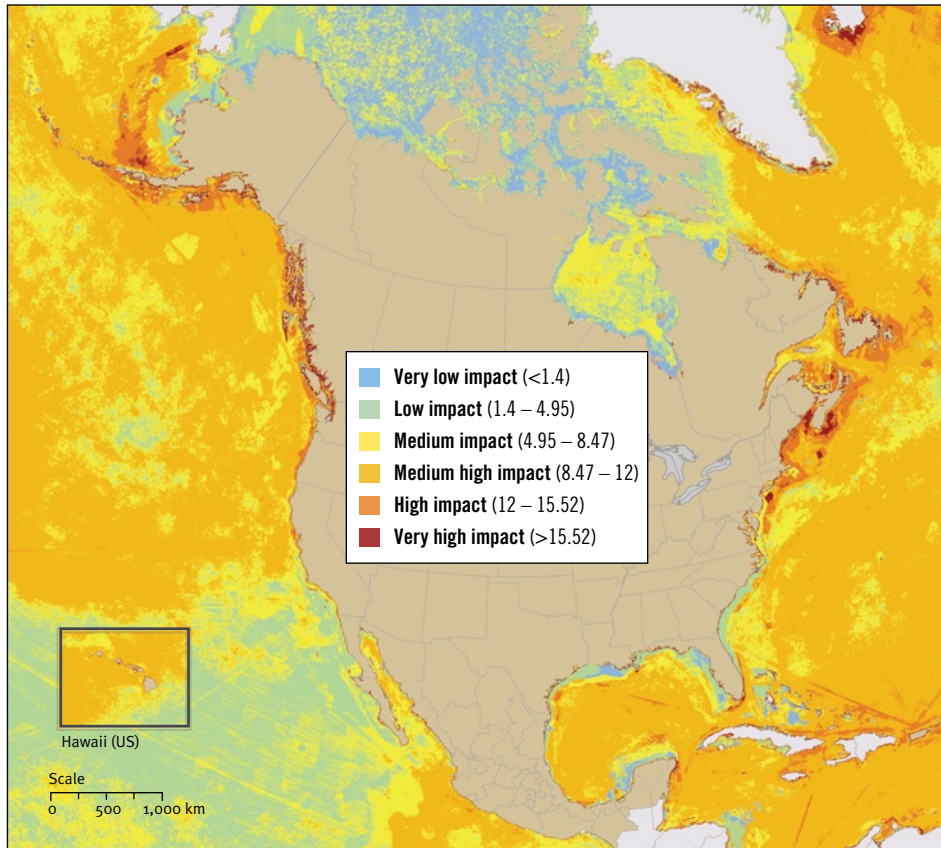
In North America, fishing pressures have been particularly acute in the north-



Source: Fisheries and Oceans Canada.



Impacts of human activities on North America's marine ecosystems



Source: Adapted from Benjamin S. Halpern, "A Global Map of Human Impact on Marine Ecosystems," *Science* 15 February 2008, 948–952.

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eastern regions, but these pressures have also been felt in the Gulf of Mexico and Caribbean, in the Gulf of California and on the West Coast. Affected species include Atlantic cod, Atlantic salmon, haddock, yellowfin tuna, flounder, grouper, red snapper and others. Overfishing affects not only target stocks, but also a wide array of species in the food web, and can cause cascading ecological effects that change the nature of marine ecosystems, sometimes permanently.

Habitat Damage and Bycatch

Overfishing is not the only problem. The unintended harmful effects of human activities in the oceans, including fishing impacts on habitats and fishing incidental take are also a concern. Habitat damage includes that to living seafloor structures as well as alterations to the geologic structures that serve as nursery areas, refuges and homes for fish and organisms living in, on or near the seafloor. This damage reduces the ability of marine ecosystems to sustain fish-

eries. Bottom gears such as dredges and bottom trawls are associated with high levels of impact on certain types of habitat.

Bycatch refers to the incidental take of fish, other vertebrates and invertebrates not targeted by fishing gear and that may be retained or discarded alive, injured or dead. Currently, almost one-quarter of what is caught by global fisheries is discarded at sea each year. Although nontarget species generally have little or no commercial value, they can become entangled or hooked accidentally during the capture of targeted species such as shrimp, swordfish or tuna. Fisheries bycatch has been implicated as an important factor in the decline of many populations of protected species, including loggerhead and leatherback sea turtles, albatrosses and petrels, sharks and marine mammals such as the vaquita porpoise (see case study). Like those associated with habitat damage, these losses can have cascading effects through marine ecosystems. Although no management strategy has yet succeeded in eliminating bycatch, effective mitigation approaches have been proposed and adopted in some cases. Examples are accounting for bycatch in fishing quotas and installing equipment such as turtle excluders, streamer lines to reduce the catch of seabirds and fine-mesh net aprons to avoid entangling dolphins. Canada, Mexico and the United States participate in domestic and international initiatives to address bycatch.

What Are the Linkages to Other North American Environmental Issues?

Oceans and fisheries are not, as once thought, vast and inexhaustible resources immune to human activity. In fact, oceans and the coastal areas that border them are linked through important ecological processes.

Land Use and Habitat

The ability of coastal systems to provide highly valued services is not limited to the marine area in question. Ocean health is intimately linked to that of adjacent marine, freshwater and terrestrial ecosystems, and vice versa. Port development, urbanization, resort development, urban sprawl, aquaculture and industrialization can destroy coastal forests, wetlands, coral reefs and other habitats. Dredging, reclamation and engineering works also account for widespread, usually irreversible destruction. Large segments of North America's coastal areas are at risk of development-related habitat conversion and decline.



The loss of wetlands, coastal sands and mudflats also has implications for fisheries, because many of these areas provide critical nursery habitat for valuable marine species. In the Arctic, the effects of climate change on coastal habitats are expected to be particularly pronounced.

Water Quality

Marine and coastal ecosystems play an important role in maintaining water balance and providing freshwater for human consumption. Freshwater is also the main link between land use and the provision of coastal ecosystem services. Land-based sources of pollutants are delivered via rivers, from runoff and through atmospheric deposition. Logging of forested areas contributes to erosion and sedimentation, leading to estuarine decline in coastal and marine ecosystems. This pressure reduces the available feeding and nursery habitats for many marine species. Agriculture introduces harmful fertilizers, nutrients and toxics into coastal ecosystems. Polluted waters entering the marine environment cause degradation, lead to loss of ecosystem services and often pose human health issues. The removal of buffers such as riparian and estuarine wetlands compounds the problem by reducing the natural waste management that these ecosystems provide. Diversion of freshwater from estuaries results in losses of water and sediment delivery to nursery areas and fishing grounds.

Climate Change

The condition of the oceans and climate change are inseparable—not only because marine and coastal systems suffer the effects of climate change, but also because oceans drive both climate and weather. Global climate change imposes additional stress on coastal and marine systems that have been degraded by chronic multiple impacts and may impede the resilience of marine and coastal ecosystems. Coastal systems are simultaneously vulnerable to rises in sea level, erosion and acute storm events.

Although all oceans are susceptible to the impacts of climate change, the relatively pristine Arctic Ocean is particularly vulnerable. Rising temperatures are already rapidly and profoundly affecting sea ice cover, ocean processes and coastal habitat integrity. When those effects are coupled with the associated increase in natural resource development and shipping activities, North Americans may find that the Arctic will require considerably more effort to protect the integrity of its marine ecosystems and the communities that depend on them. 🐞

Case Study – The Vaquita

The vaquita (*Phocoena sinus*), a small porpoise endemic to the northern Gulf of California, Mexico, is the most critically endangered marine small cetacean in the world—it is estimated that the population numbers only about 150. The vaquita is threatened primarily by the fishing gill nets used to catch fish and shrimp. Although other risk factors are the trawling that affects vaquita behavior and the uncertain effects of dam construction on the Colorado River and the resultant loss of freshwater input to the upper Gulf, entanglement is the clearest and most immediate concern.



Photo: Omar Vidal.

Captive breeding is not feasible for vaquitas because of the difficulty in capturing these small, solitary elusive animals in relatively deep water and the complete lack of experience with this species in captivity.

In only a few years, the options for conserving the vaquita will be severely reduced. Although conservation groups, concerned scientists and government officials in Mexico have invested significant time and financial resources in vaquita conservation over the last 25 years, progress toward reducing entanglement has been slow, in spite of efforts to phase out gill nets in the vaquita's core range and provide compensation schemes for fishermen. Indeed, the Biosphere Reserve in the northern Gulf has fallen far short of its potential for vaquita conservation. On 29 December 2005, Mexico declared the area in which about 80 percent of verified vaquita sightings had been made a Vaquita Refuge. In the same decree, the state governments of Sonora and Baja California were offered \$1 million to compensate affected fishermen. The effectiveness of this major initiative remains to be seen.